

SEWER MANHOLE REHABILITATION - STRUCTURAL COMPOSITE LINING  
(as provided by AP/M Permaform)

1	Intent: .....	2
2	Applicability:.....	2
3	Referenced Standards .....	2
4	Related Sections .....	2
5	Structural Composite Lining .....	2
6	Submittals.....	6
7	Product Handling.....	6
8	Quality Assurance and Acceptance .....	7
9	Measurement for Payment: .....	7

# SEWER MANHOLE REHABILITATION - STRUCTURAL COMPOSITE LINING PERMACAST® and COR+GARD® BY AP/M PERMAFORM®

- 1 **Intent:** It is the intent of this specification to provide minimum standards for materials and methods for waterproofing, sealing, structural reinforcement and corrosion protection of existing manholes, wet wells and similar underground structures from the cover to the channel. This specification offers flexibility in design by offering technologies available for repairing the various defects found in sanitary sewer structures from minor leaks to complete structural failure.
- 2 **Applicability:** These repair means and methods may be engineered for the depth, diameter, shape, traffic loading, groundwater pressures and condition of each manhole.
- 3 **Referenced Standards**
  - 3.1 ASTM D-695 Standard Test Method for Compressive Properties of Rigid Plastics
  - 3.2 ASTM D-790 Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
  - 3.3 ASTM D-638 Standard Test Method for Tensile Properties of Plastics
  - 3.4 ASTM C-882 Standard Test Method for Bond Strength of Epoxy Systems Used with Concrete by Slant Shear
  - 3.5 ASTM D-4541 Pull-off Strength of Coatings Using a Portable Adhesion Tester
  - 3.6 ASTM D-4414 Standard Practice for Measurement of Wet Film Thickness of Organic Coatings by Notched Gages
  - 3.7 NACE RP0274 High Voltage Electrical Inspection of Pipeline Coating Prior to Installation
  - 3.8 ASTM F2304-03 Standard Practice for Rehabilitation of Sewers Using Chemical
  - 3.9 NACE 6/ SSPC-SP 13 Surface Preparation of Concrete Grouting.
- 4 **Related Sections**
  - 4.1 Structural Cementitious Lining
  - 4.2 Manufactured Frame-Chimney Insert – I & I Barrier
  - 4.3 Applied Frame – Chimney Internal Seal
- 5 **Structural Composite Lining**
  - 5.1 See section on Structural Cementitious Lining
  - 5.2 Once the cementitious base layer has been applied to seal, reinforce and smooth the existing interior surface, the COR+GARD® epoxy is applied at a minimum thickness of .065 “ (1.65 mm) to provide a complete and uniform vapor barrier against attack by sewer gases and corrosion causing bacteria. The surface shall be free of entrapped air bubbles or holidays.
  - 5.3 COR+GARD® is a two-component 100% solids epoxy design formulated for use in sewer systems. It is light green in color for enhanced visibility and may be applied robotically from the PERMACAST® patented robotic applicator for uniform distribution over the entire interior surface without requiring entry and its corresponding safety requirements. Centrifugal casting avoids air bubble entrapment. COR+GARD® will cure quickly, even when immersed in fresh or salt water and rapidly forms a tenacious bond to freshly applied PERMACAST® mortars which are formulated to prevent delaminating calcium powders from forming during hydration. COR+GARD® composite produces a smooth,

glossy and homogenous protective layer that is impervious to biological corrosion, water, oils and most chemicals.

- 5.4 COR+GARD® II is a two-component 100% solids epoxy especially formulated for use in sewer systems where increased flexibility is required. It is light green in color for enhanced visibility. It will cure quickly, even when immersed in fresh or salt waters. It quickly forms a tenacious bond to freshly applied mortars. Cor+Gard II application produces a smooth, glossy and homogenous protective layer that is impervious to water, oils and most chemicals.
- 5.5 COR+GARD® 301 is a two-component 100% solids epoxy especially formulated for use in sewer systems where increased tensile strength is required. It is light green in color for enhanced visibility. It will cure quickly, even when immersed in fresh or salt waters. It quickly forms a tenacious bond to freshly applied mortars. COR+GARD® 301 application produces a smooth, glossy and homogenous protective layer that is impervious to water, oils and most chemicals.
- 5.6 COR+GARD® 501 is a two-component 100% solids Novolac epoxy especially formulated for use in chemically aggressive sewer systems. It is gray in color and may be applied robotically from the PERMACAST® patented robotic applicator for uniform distribution over the entire interior surface of manholes, pipe, and similar structures without requiring entry. It quickly forms a tenacious bond to freshly applied PERMACAST® mortars, which are engineered to prevent delaminating powders from forming during hydration. COR+GARD® 501 application produces a high-build coating for continuous immersion in aggressive environments where high chemical resistance is required. COR+GARD® 501 has excellent resistance to concentrated sulfuric acid, as well as alkalis and most

#### 5.7 Physical Properties

Dry Time	See Product Data Sheet
Compressive Strength ASTM D-695	See Product Data Sheet
Flexural Strength ASTM D-790	See Product Data Sheet
Tensile Strength ASTM D-638	See Product Data Sheet
Hardness ASTM D-2240	See Product Data Sheet
Heat Distortion ASTM D-648	See Product Data Sheet
Ultimate Elongation ASTM D-638	See Product Data Sheet
Adhesive Shear ASTM C-882	See Product Data Sheet

The cured epoxy shall have the following HMIS Rating. Health: 0 Fire: 1 Reactivity: 0

#### 5.8 Structural Composite Installation

- 5.8.1 COR+GARD® 100% solids epoxy shall be applied over the fresh PERMACAST® liner to create a vapor barrier impervious to the chemical corrosion.

##### 5.8.2 Moisture Content and Mortar Age Considerations

- 5.8.2.1 COR+GARD® may be applied when the MS-10,000 mortar has taken a final set (8-12 hrs) or when moisture from free water escape during hydration is no longer observed.
- 5.8.2.2 When time constraints do not allow for waiting for the final set, the surface may be conditioned to accept the COR+GARD® by applying Primer. See tables 3 and 4 for application and curing schedules.

5.8.2.3 Apply epoxy primer directly to the new MS-10,000 surface as soon as the surface water has disappeared. The surface may be damp but not wet. The moisture in the concrete & repair mortar is in no way harmful to the penetration or adhesion of the coating. The depth of penetration may be as much as 1/16" to 1/4". The epoxy primer acts in two ways: (1) It penetrates the mortar and acts as a primer, and (2) it forms a thin film on the mortar which is water resistant and relatively impervious, holding the water in and acting as a concrete curing compound.

5.8.2.4 Primer is top coated with COR+GARD® after primer has achieved its initial set, but while in a tacky condition. If Primer has dried hard to touch before top coating, an additional coat of primer must be applied.

**Table 3 - Application Condition (Primer)**

Condition	Material	Surface	Ambient	Humidity
Optimum	60°-90°F	75°F	75°F	0-95%
Minimum	50°F	40°F	50°F	0%
Maximum	95°F	120°F	100°F	95%

**Table 4 - Curing Schedule (Primer)**

Surface Temp. & 50% Relative Humidity	Dry to Topcoat	Maximum Recoat Time
50°F	1.5 hours	8 hours
75°F	1 hours	5 hours
90°F	.7 Hours	3 hours

5.8.3 Weather Considerations / Weather Atmosphere

5.8.3.1 Rising mortar temperatures during COR+GARD® application may cause blistering and pinhole problems caused by out-gassing from the mortar.

5.8.3.2 Monitoring the dew point during periods of changing weather is recommended to ensure that COR+GARD® is not applied over excess moisture that has condensed on the mortar surface.

5.8.3.3 Avoid applying COR+GARD® during rain events that can saturate the newly prepared substrate with excess water.

5.8.3.4 See tables 5 and 6 below for optimum temperatures and conditions for COR+GARD® application.

5.8.3.5 If rapid cure is required, cure times can be reduced and product performance enhanced by artificially applying heat during the curing process.

**Table 5 - COR+GARD® Application Condition**

<b>Condition</b>	<b>Material</b>	<b>Surface</b>	<b>Ambient</b>	<b>Humidity</b>
<b>Optimum</b>	60 °-90 °F	75 °F	75 °F	0-95%
<b>Minimum</b>	60 °F	55 °F	60 °F	0%
<b>Maximum</b>	95 °F	115 °F	100 °F	95%

**Table 6 - COR+GARD® Curing Schedule**

<b>Surface Temperature &amp; 50% Relative Humidity</b>	<b>Dry to Topcoat</b>	<b>Maximum Recoat Time</b>	<b>Cure for Immersion Service</b>
50 °F	4 hours	24 hours	8 hours
75 °F	3 Hours	18 hours	6 hours
90 °F	2 Hours	12 hours	4 hours

#### 5.8.4 Mixing

- 5.8.4.1 Combine equal parts of A & B Components in a clean dry pail. Do not mix by hand. Mix each pail of COR+GARD® using a power mixer (e.g. ½” drill motor and Jiffy mixer paddle). Do not incorporate air into the mix. Mix thoroughly for full 3 minutes. After mixing allow mixed components to induce (sweat-in) for 20-30 minutes at temperatures below 75°F before beginning application. Care should be taken to decrease induction time as temperatures rise above 75°F to avoid flash setting. Metered plural component epoxy pumps may also be utilized to mix and dispense the epoxy through a spray gun or SpinCaster™.

#### 5.8.5 Applying the Epoxy

- 5.8.5.1 If application is delayed beyond 24 hours, or if the prepared mortar liner is exposed to foreign matter, it shall be rinsed to neutralize its surface and the epoxy shall then be applied.
- 5.8.5.2 The epoxy shall be uniformly applied onto the prepared mortar lining before re-exposure to chemicals can contaminate the underlying mortar. It is recommended that two coats of epoxy be applied to reduce pinholes. The second coat will act to repair the pinholes that develop in the first coat due to epoxy filling imperfections in the substrate. The epoxy shall be applied at a minimum thickness of .065” (65 mils) to provide a complete and uniform vapor barrier.
- 5.8.5.3 Optionally, fiberglass woven fabric may be rolled into the resin or chopped glass spray applied with the resin for added tensile and

flexural strength where desired, such as the crown of pipes or weakened walls. The fiberglass fabric shall be cut to the required dimensions and pressed, using a putty knife, into the epoxy to achieve full wetting of the fabric. With subsequent applications of the fabric, the edges shall be either overlapped or butt-joined, at the discretion of the applicator. COR+GARD® shall be applied between the overlapped edges to assure a monolithic construction. Butted joints shall be coated with COR+GARD® and covered with a 4-inch wide fiberglass seaming-strip (cap-strip) to assure the monolithic construction. The fabric shall be top coated with COR+GARD®. This assures complete saturation and encapsulation of the fabric, with a finished lining thickness of approximately 125-mils. The entire wall structure, from rim to bench, shall be lined in this fashion. The Reinforcing fabric shall be an 18-ounce fiberglass bonded fabric of Type E glass having a tensile strength of 500,000 psi, a modulus of elasticity of 10.5 million psi and a maximum elongation of 4.8%. The fabric shall be stitch-bonded construction with a chemical binder to enhance wet out, handling and adhesion.

5.8.5.4 Sloped surfaces of the floor may be made slip resistance by broadcasting aluminum oxide or silica sand into the surface prior to gelling.

5.8.5.5 Cleanup: Upon completion, the Contractor shall clean up the work site and properly dispose any excess material or debris

## **6 Submittals**

6.1 All submittals shall conform to the requirements of the Contract document.

6.2 In addition, the following items may be required of the installer to be submitted to the engineer at the sole discretion of the engineer. This Contract shall not be considered complete until receipt and acceptance of the following:

6.2.1 Reference submittals

6.2.1.1 Contractor certification

6.2.1.2 Material certification

6.2.2 Product data

6.2.2.1 Patching and plugging material

6.2.2.2 Cementitious lining material

6.2.2.3 Epoxy coating composite

## **7 Product Handling**

7.1 Special handling is not required for PERMACAST® mortar. Normal precautions for "nuisance dust" shall be observed. Consult Material Safety Data Sheet for details.

7.2 Proper protective clothing and breathing apparatus shall be used to avoid direct contact with the liquid components of COR+GARD® composite if hand spraying or brushing COR+GARD® is by man entry. When spraying COR+GARD® with spinner head, breathing apparatus is not required. Manufacturer's material safety data sheets shall be kept on site and the applicator shall ensure familiarization with this information and emergency procedures.

- 7.3 Personnel entry is not required to rebuild the interior wall of most manholes when using the PERMACAST® spinner head. If personnel entry becomes necessary for any reason, OSHA standards for confined space entry shall be strictly observed.

## **8 Quality Assurance and Acceptance**

- 8.1 Visual inspection should verify a leak-free, uniform appearance.
- 8.2 Applied wet film thickness shall be verified per ASTM D-4414, Standard Practice for Measurement of Wet Film Thickness of Organic Coatings by Notched Gages.
- 8.3 The protective coating shall be spark tested per NACE RP0274 at 100 volts per mil of dry film thickness. The dielectric strength of coatings will vary from manufacturer to manufacturer. If this value is unknown, it is recommended that a holiday be created in the coating and the tester be calibrated to the voltage that detects the flaw.
- 8.4 At the discretion of the engineer, a portable adhesion tester may be used to verify bond strength of the COR+GARD® protective coating per ASTM D-4541, Pull-off Strength of Coatings Using a Portable Adhesion Tester. Care should be taken to conduct the test on a flat surface. Special equipment may be necessary to compensate for the walls of round sewer structures.

## **9 Measurement for Payment:**

- 9.1 Payment shall be made at the unit price per vertical feet of finished wall for each prescribed thickness.